

COLORADO RIVER RECOVERY PROGRAM
FY-2005 and FY 2006--2007 PROPOSED SCOPE OF WORK for:

Project No.: 145

(Research Framework for the Upper Colorado River Basin, June 22, 2003)

Lead Agency: Larval Fish Laboratory, Colorado State University

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Category:

☐ Ongoing project

☐ Ongoing-revised project

☒ Requested new project

☐ Unsolicited proposal

Expected Funding Source:

☒ Annual funds

☐ Capital funds

☐ Other (explain)

I. Title of Proposal:

Research Framework for the Upper Colorado River Basin

II. Relationship to RIPRAP:

V. Monitor Populations and Habitat and Conduct Research to Support Recovery Actions (Research, Monitoring, and Data Management)

III. Study Background/Rationale and Hypotheses:

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) coordinates recovery activities for the endangered Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), and bonytail (*Gila elegans*) in the upper Colorado River basin. Guidance for research, monitoring, and other management actions is provided annually through a Recovery Implementation Program Recovery Action Plan (RIPRAP). Management actions are designed to remove or minimize threats and assist species recovery. Annual monitoring of Colorado pikeminnow and humpback chub assesses population size, trends, and

recruitment. Management actions are designed to benefit the endangered and other native fishes, but the linkages between these actions and population dynamics have not been delineated.

Annual population estimates of Colorado pikeminnow and humpback chub for 2000–2003 showed an apparent decline in numbers of adults. Causes for this apparent recent decline are not self-evident. Past and ongoing Recovery Program management actions address the most serious of known perceived threats to the species. The cause for apparent recent declines is concerning, but unknown, and the Recovery Program seeks to better understand possible causative factors.

The Recovery Program, with assistance from The Nature Conservancy and other environmental interests, has identified the need for a research framework that will track and link population monitoring with appropriate management actions through the concept of adaptive management. The goal of this project is to establish a framework for an iterative process of linking fish population patterns with Recovery Program management actions. This process would be refined over time as new information is gained to prioritize research and management actions that facilitate species recovery in a timely, efficient, and effective manner.

Hypothesis Statement:

The overriding hypothesis of this work is that population dynamics of the four endangered fish are determined by intrinsic and extrinsic factors that affect reproduction, survival, and recruitment of juveniles to adults from year to year. These factors include environmental stressors that may limit population size and may be controlled through management actions; or these factors may include climate (such as, periods of drought) or other natural factors. The recovery program implements management actions through the RIPRAP that are designed and intended to remove or minimize effects of human-induced environmental stressors that threaten the endangered fish species. This project will determine if management actions are addressing these threats, as well as evaluate the effectiveness of these actions for each of the four endangered fish species.

IV. Study Goals, Objectives, End Product:

Study Goal

The goal of this research framework is to better understand how management actions are addressing factors that contribute to dynamics of endangered fish populations. The study will be conducted in two phases described under Objectives. Phase I will be implemented and completed first. Phase II will be implemented contingent upon approval by the Biology Committee and the Recovery Program office of a Phase I Report and an updated SOW. The purpose of this project is to repackage program actions for improved clarity to program participants, and to provide an informational tool for decision-makers.

Objectives

This project will be conducted as two phases. Phase I establishes a conceptual framework for linkages between species threats by life stage and past and ongoing management actions. Phase II, if implemented, would involve analyses of appropriate data sets to identify associations between fish population dynamics and environmental factors. The purpose of each phase and the associated objectives are:

PHASE I.—Evaluate How Effectively RIPRAP Management Actions Address Species Threats

1. Develop conceptual life history models for each of the four endangered fish species to be used as a framework for identifying stressors to various life stages and for developing additional management actions and monitoring programs, as needed; and
2. Link RIPRAP management actions with the species conceptual models in a hypothesis framework in order to track and link resource response with management actions. Specifically, this task will:
 - a. Identify monitoring programs in place to track resource responses and identify gaps,
 - b. Identify management actions that address threats, and identify gaps, and
 - c. Identify controllable and uncontrollable factors.

PHASE II.—Identify and Delineate Associations between Environmental Stressors and Fish Population Dynamics

1. Identify available data sets that may provide insight into species life history and environmental stressors;
2. Conduct a quantitative analysis, as appropriate, of prior and recent data to identify associations between endangered or native fish population patterns and environmental stressors, especially river flow, temperature, and nonnative fish species;
3. Develop hypotheses for population declines related to associations; and
4. Develop recommendations for additional monitoring or management actions to test and evaluate hypotheses.

End Products

PHASE I.—Evaluate How Effectively Management Actions Address Species Threats

The end products of this first phase will be:

1. Four conceptual life history models, one each for Colorado pikeminnow, humpback chub, razorback sucker, and bonytail, that identify and describe principal environmental stressors to various life stages; and

2. A spreadsheet and summary report that identifies principal RIPRAP management actions and monitoring programs and tracks and links each to environmental stressors and resource response by species.

PHASE II.—Identify and Delineate Associations between Environmental Stressors and Fish Population Dynamics

The end products of this second phase will be:

1. A list and brief description of available data sets that may provide correlates into species life history and environmental stressors;
2. A quantitative analysis and summary report of prior and recent data to identify associations between endangered or native fish population patterns and environmental stressors, including, but not limited to river flow, temperature, and nonnative fish species;
3. A list of hypotheses for population declines related to associations; and
4. A list of recommendations for additional monitoring or management actions needed to test and evaluate hypotheses.

V. Study Area:

Upper Colorado River Basin (excluding the San Juan River Subbasin)

VI. Study Methods/Approach:

Note: Recovery Program participants believe that Phase I of this project should be implemented as soon as possible. This SOW was developed promptly to expedite project implementation, but transfer of funds to the Larval Fish Laboratory and establishment of a subcontract from Colorado State University to SWCA will take time and may delay the initiation schedule. Program Participants will be advised of the official project initiation date via the Biology Committee at the time that funds are transferred and appropriate agreements and subcontracts are in place.

PHASE I.—Evaluate How Effectively Management Actions Address Species Threats

Task I-1. Conceptual Life History Models.

The life history of each of the four endangered fishes is sufficiently understood to develop conceptual life history models for each species; i.e., Colorado pikeminnow, humpback chub, razorback sucker, and bonytail. These life history models will help to provide an understanding of the ecology and life history of each species and environmental linkages that are likely principal stressors to various life stages.

These life history models will be developed by the principal scientists involved in this project, as well as the Recovery Program Office. Input on the models and associated environmental stressors will be solicited from the Biology Committee at one of their

regular meetings, and from external peer reviewers, if the Biology Committee deems necessary. Identification of stressors will lead to hypotheses about how these stressors affect one or more life stages of a species. This list of stressors will also be prioritized as to magnitude and immediacy of threat in order to identify priority management actions. Examples of life history models and their development process for Colorado pikeminnow can be found in Bestgen et al. (1997) and Muth et al. (2000). Scientists from the Larval Fish Laboratory will take the lead on development of these models.

These life history models will be used in concert with other existing information to assess the effectiveness of management actions identified and implemented under the RIPRAP and evaluated in Task I-2. The species-specific models will be used to identify information needs and threats or environmental stressors among species. The models will provide an iterative feedback mechanism for information and will be used to cross-link management actions among species. A generalized model may be developed to better illustrate these cross-linkages and management actions that should benefit more than one species.

These life history models will provide an accounting of the environmental stressors that most likely threaten the species, and help to identify necessary management actions to remove or minimize the stress or threat. These models will serve as a means to identify available data and data gaps, determine potential data analyses, and identify research and management actions to remediate the priority and most substantial known stressors. This process will be used to compare necessary management actions that address environmental stressors against ongoing and proposed RIPRAP management actions. RIPRAP management actions will be tracked under linked evaluation system described in Task I-2 of this scope of work.

These models will serve as a common forum for communications about the life history of each species. Each model will portray life history aspects for each species from egg to adult with compartments representing state variables and lines or arrows representing rate variables. Threats to each life stage will be identified and prioritized according to magnitude and immediacy of threat. These conceptual models will be used as the foundation for linking management actions from RIPRAP elements. Development of each of the four life history models is expected to be a straight-forward process. The life history models will be provided to the Biology Committee for review and comment at one of the regular Biology Committee meetings.

Task I-2. Evaluation of RIPRAP Management Actions.

Through research, the Recovery Program has identified and implemented many management actions designed and intended to remove or minimize species threats. These actions include providing flows, removing nonnative fish, habitat restoration, stocking hatchery fish and construction of fish passage. The Recovery Program evaluates these management actions through monitoring and under the concept of adaptive management, may revise or refine actions according to achievement of prior expectations.

Success of management actions can often be measured as a response by the target resource, but response by the endangered species may be more difficult to assess. For example, success of northern pike removal can be measured as numbers of pike removed and estimates of remaining pike populations, fish size, reproduction, and recruitment. However, population dynamics of Colorado pikeminnow are influenced by many intrinsic factors (i.e., internal population characteristics such as reproduction, survival, recruitment) and extrinsic factors (e.g., climate, available habitat, food abundance), and response to an applied management action may not be self-evident. If the factor identified as a threat is indeed substantial and limiting, then a response may be anticipated sooner rather than later. Other extrinsic factors or environmental variables that change dramatically within the same time frame would tend to obscure, delay, or add to the variability of the response. Populations of endangered fish respond to the sum of environmental factors, including hydrology, water quality, temperature, climate, sympatric species, etc. The approach by the Recovery Program is to ameliorate as many anthropogenic factors as possible that are considered threats to the species and to assess response by monitoring population dynamics of the endangered species. Hence, response to Recovery Program actions is evaluated collectively, with the goal of establishing and maintaining secure, self-sustaining populations.

An evaluation of primary Recovery Program activities will be conducted and compared with principal environmental stressors identified in Task I-1, in order to determine if appropriate management actions are being implemented. To begin, this evaluation will identify primary RIPRAP management actions implemented in the last 10 years and on spreadsheet format address the following:

1. Link to threat for each species by life stage from Task I-1;
2. Management action from the RIPRAP for associated threat;
3. General hypothesis describing prior expected result or action;
4. Term or duration of action;
5. Monitoring program/study to evaluate response;
6. Observed or measured response to action;
7. Evaluation of success compared to prior expectation, based on reports;
8. Recovery Program decision to resume or suspend action; and
9. Subsequent revised or refined action, if any.

Scientists from SWCA will take the lead on evaluation of Recovery Program actions.

NOTE: Phase II of this SOW is preliminary and may be adjusted by tasks, schedule, and budget, according to the results of Phase I and pending approval of the Biology Committee. It is provided in this SOW to provide a perspective of direction and possible future proposed work on this project.

PHASE II.—Identify and Delineate Associations between Environmental Stressors and Fish Population Dynamics

Task II-1. Assimilate Available Data Sets.

A great deal of data and information have been gathered for the four endangered species and associated fishes of the upper Colorado River basin for nearly 40 years. Much of this information has been variously reported, most often in reports and publications by the principal investigator(s) collecting the information. A comprehensive analysis of these data would be time-consuming and costly, and would not be the most prudent approach for linking key environmental correlates with fish population dynamics. Instead, hypotheses developed from Task I-1 will be used to analyze select data sets to investigate specific environmental linkages.

Data sets that may provide insight into species life history and environmental factors will be identified to gain an understanding of the scope of analyses that might be needed to identify these linkages. The most applicable and available data sets will be procured that may identify associations among endangered, native, and nonnative fish species, as well as between fish populations and environmental variables. These data sets may include, but are not limited to, ISMP, hydrology, temperature, habitat, and nonnative fish. Environmental variables will be identified from these data sets that may link with fish population trends.

Task II-2. Quantitative Analysis of Prior and Recent Data to Identify Associations.

Quantitative analyses will be conducted on environmental correlates and native fish population patterns to test hypotheses about associations and possible linkages. Initially, the focus of this analysis will be on one species to demonstrate the analytical approach and results; additional species will be evaluated based on Biology Committee approval. Demonstrated linkages between environmental correlates and population patterns may not necessarily reflect causation. These analyses will be conducted at various scales, depending on the resolution of driving hypotheses. These hypotheses will be developed jointly by lead scientists on this project with assistance from the Biology Committee of the Recovery Program. One possible hypothesis is that basin-specific hydrologic and river geomorphic characteristics influence population patterns; e.g., fish population data collected concurrently during 2000-2003 on the middle Green River, Yampa River, and Upper Colorado River can be analyzed with flow patterns (e.g., data sets are available from Recovery Program population estimates and Colorado Division of Wildlife fish species association studies, R. Anderson).

We emphasize that these analyses will not be an exhaustive or comprehensive examination of all available program data; that effort would be substantial and costly. The purpose of this data analysis is to try to identify those most apparent or perhaps overlooked associations that will help to guide ongoing and future management actions to further the conservation of the four endangered fishes.

VII. Task Description and Schedule:

Schedule

PHASE I	FY-2005				FY-2006												FY-2007					
Tasks	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
I-1. Models																						
I-2. Evaluation																						
I-3. Reports																						
--Draft Report																						
--Review by RPO																						
--Review by BC																						
--Final																						
PHASE II	FY-2005				FY-2006												FY-2007					
Tasks	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
II-1. Data Sets																						
II-2. Analysis																						
II-3. Reports																						
--Draft Report																						
--Review by RPO																						
--Review by BC																						
--Final																						

PHASE I

Task I-1. Conceptual Life History Models.

September 30, 2005

Task I-2. Evaluation of RIPRAP Management Actions.

September 30, 2005

Task I-3. Report Preparation.

Phase I estimated to start July 1, 2005; Draft report to Recovery Program Office October 31, 2005; to peer review and Biology Committee November 30, 2005; Final to Biology Committee February 28, 2006.

PHASE II

Task II-1. Available Data Sets.

July 31, 2006

Task II-2. Quantitative Analysis of Prior and Recent Data to Identify Associations.

September 30, 2006

Task II-3. Report Preparation.

Phase II estimated to start April 1, 2006; Draft report to Recovery Program October 31, 2007; to peer review and Biology Committee November 30, 2007; Final to Biology Committee February 28, 2007.

VIII FY-2005 Work (Larval Fish Laboratory salaries reflect 20.1% fringe benefit costs. All items including salary and benefits (except equipment > \$5,000) will be assessed the standard 15% overhead rate.)

Task I-1. Conceptual Life History Models (September 30, 2005).

Labor	Work days	Cost
LFL Project Leader (\$425/day)	12	\$5,100
SWCA Project Leader (\$720/day)	2	1,440
LFL Biologist (\$240/day)	10	2,400
Travel (2 trips to Biology Committee Meeting)		1,500
Materials		0
Task Subtotal:		\$ 10,440

Task I-2. Evaluation of RIPRAP Management Actions (September 30, 2005).

Labor	Work days	Cost
SWCA Project Leader (\$720/day)	12	\$8,640
LFL Project Leader (\$425/day)	2	850
SWCA Biologist (\$400/day)	10	4,000
Travel (1 trip Logan to Denver)		750
Materials (copies)		500
Task Subtotal:		\$14,740

PHASE I BUDGET SUMMARY FOR FY-05

Task	LFL	SWCA	Total Cost
I-1. Life History Models	\$ 8,250	\$ 2,190	\$ 10,440
I-2. RIPRAP Evaluation	\$ 850	\$ 13,890	\$ 14,740
PHASE I Subtotal:	\$ 9,100	\$ 16,080	\$ 25,180
LFL Overhead Rate (15%)	\$ 1,365	\$ 2,412	\$ 3,777
PHASE I Total For FY-06:	\$10,465	\$ 18,492	\$ 28,957

VIII FY-2006 Work

Task I-3. Report Preparation (February 28, 2006).

Labor (LFL & SWCA)-	Work days	Cost
LFL Project Leader (\$425/day)	10	\$4,250
SWCA Project Leader (\$720/day)	10	7,200
SWCA Editor (\$400/day)	5	2,000
Travel (2 trips to Biology Committee Meeting)		1,500
Materials (Report Copies)		500
Task Subtotal:		\$15,450

PHASE I BUDGET SUMMARY FOR FY-06

Task	LFL	SWCA	Total Cost
I-3. Report Preparation	\$ 5,000	\$ 10,450	\$15,450
PHASE I Subtotal:	\$ 5,000	\$ 10,450	\$15,450
LFL Overhead Rate (15%)	\$ 750	\$ 1,568	\$ 2,318
PHASE I Total For FY-07:	\$ 5,750	\$ 12,018	\$ 17,768

VIII FY-2006 Work--Continued
(Costs estimates for Phase II are preliminary and will depend on numbers and complexity of available data sets)

PHASE II

Task II-1. Assimilate Available Data Sets (July 31, 2006).

Labor (Larval Fish Laboratory)-	Work days	Cost
LFL Project Leader (\$425/day)	12	\$5,100
SWCA Project Leader (\$720/day)	2	1,500
LFL Biologist (\$240/day)	10	2,400
Travel		0
Materials		0
Task Subtotal:		\$9,000

Task II-2. Quantitative Analysis (September 30, 2006).

Labor	Work days	Cost
LFL Project Leader (\$425/day)	30	\$12,750
SWCA Project Leader (\$720/day)	10	7,200
LFL Biologist (\$240/day)	30	7,200
Expert reviewer, statistical assistance (\$600/day)	8	4,800
Travel (1 trip Logan to Ft. Collins)		750
Materials		0
Task Subtotal:		\$32,700

PHASE II BUDGET SUMMARY FOR FY-06

Task	LFL	SWCA	Total Cost
II-1. Data Sets	\$ 7,500	\$ 1,500	\$ 9,000
II-2. Analysis	\$24,750	\$ 7,950	\$32,700
PHASE II Subtotal:	\$32,250	\$ 9,450	\$41,700
LFL Overhead Rate (15%)	\$ 4,838	\$ 1,417	\$ 6,255
PHASE II Total For FY-07:	\$37,088	\$10,867	\$47,955

VIII FY-2007 Work

Task II-3. Report Preparation (February 28, 2007).

Labor (LFL & SWCA)-	Work days	Cost
LFL Project Leader (\$425/day)	17	\$ 7,225
SWCA Project Leader (\$720/day)	20	14,400
SWCA Editor (\$400/day)	5	2,000
Travel (2 trips to Biology Committee Meeting)		1,500
Materials (Report Copies)		500
Task Subtotal for FY-08:		\$25,625

PHASE II BUDGET SUMMARY FOR FY 07

Task	LFL	SWCA	Total Cost
II-3. Report Preparation	\$ 7,975	\$17,650	\$25,625
PHASE II Total:	\$ 7,975	\$17,650	\$25,625
LFL Overhead Rate (15%)	\$ 1,196	\$ 2,648	\$ 3,844
PHASE II Total For FY-08:	\$ 9,171	\$20,298	\$29,469

IX. Budget Summary

	LFL	SWCA	Total Cost
FY-2005 (PHASE I)	\$10,465	\$ 18,492	\$ 28,957
FY-2006 (PHASE I)	\$ 5,750	\$ 12,018	\$ 17,768
FY-2006 (PHASE II)	\$37,088	\$10,867	\$ 47,955
FY-2007 (PHASE II)	\$ 9,171	\$20,298	\$ 29,469
Total:	\$62,474	\$61,675	\$ 124,149

X. Reviewers - Robert Muth, Tom Czapla, Members of the Biology Committee

XI. References

Bestgen, K. R., D. W. Beyers, G. B. Haines, and J. A. Rice. 1997. Recruitment models for Colorado squawfish: Tools for evaluating the relative importance of natural and managed processes. Unpublished report to the National Biological Survey and National Park Service, Fort Collins, Colorado. 55 pp.

Muth, R. T., L. W. Crist, K. E. LaGory, J. W. Hayse, K. R. Bestgen, T. P. Ryan, J. K. Lyons, and R. A. Valdez. 2000. Flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. Final Report FG-53 to the Upper Colorado River Endangered Fish Recovery Program.